CLAIMS

1. A fuel cell comprising: at least

a membrane electrode assembly having an anode, a cathode and a polymer electrolyte membrane disposed between said anode and said cathode;

an anode-side separator and a cathode-side separator that sandwich said membrane electrode assembly and face to each other;

a cooling fluid channel for supplying and exhausting a cooling fluid for cooling said membrane electrode assembly which is formed in at least one of said anode-side separator and said cathode-side separator;

a fuel gas channel for supplying and exhausting a fuel gas serving as a reaction gas to said membrane electrode assembly which is formed in said anode-side separator;

an oxidant gas channel for supplying and exhausting an oxidant gas serving as a reaction gas to said membrane electrode assembly which is formed in said cathode-side separator;

an anode-side gasket for sealing said reaction gas which is disposed in the outer portion of said membrane electrode assembly and on the main surface of said anode-side separator facing said membrane electrode assembly; and

a cathode-side gasket for sealing said reaction gas which is disposed in the outer portion of said membrane electrode assembly and on the main surface of said cathode-side separator facing said membrane electrode assembly such that said cathode-side gasket faces to said anode-side gasket;

wherein said cooling fluid channel, said fuel gas channel and said oxidant gas channel are formed such that their main portions are substantially parallel to each other;

an upstream portion of said cooling fluid channel of at least one of said anode-side separator and said cathode-side separator is formed such that it includes at least one of a region corresponding to said anode-side gap and a region corresponding to said cathode-side gap, and said upstream portion of said cooling fluid channel is formed such that it includes a region corresponding to middle stream portion and subsequent portion of at least one of said fuel gas channel and said oxidant gas channel, in order to allow water vapor contained in said reaction gas that flows into an anode-side gap formed between said anode-side gasket and said membrane electrode assembly and water vapor contained in said reaction gas that flows into a cathode-side gap formed between said cathode-side gasket and said membrane electrode assembly to condense in at least a part of said anode-side gap and said cathode-side gap, and to allow the condensed water to fill at least one of said anode-side gap and said cathode-side gap.

2. The fuel cell in accordance with claim 1,

wherein said polymer electrolyte membrane has a larger main surface than main surfaces of said anode and said cathode, and entire periphery of the main surface of said polymer electrolyte membrane extends outwardly beyond a periphery of main surface of said anode and a periphery of main surface of said cathode,

said anode-side gasket and said cathode-side gasket

are disposed between said anode-side separator and said cathode-side separator such that said anode-side gasket and said cathode-side gasket face to each other and they sandwich the entire periphery of said polymer electrolyte membrane;

said anode-side gap comprises a space including said polymer electrolyte membrane, said anode-side gasket, said anode-side separator and an end face of said anode; and

said cathode-side gap comprises a space including said polymer electrolyte membrane, said cathode-side gasket, said cathode-side separator and an end face of said cathode.

3. The fuel cell in accordance with claim 1,

wherein said upstream portion of said cooling fluid channel of said anode-side separator is formed in a region corresponding to said anode-side gap so that said water vapor of said reaction gas that flows into said anode-side gap is condensed and said cathode-side gap is filled with the condensed water.

4. The fuel cell in accordance with claim 1,

wherein said upstream portions of said cooling fluid channels of said anode-side separator and said cathode-side separator are formed such that they include at least one of said region corresponding to said anode-side gap and said region corresponding to said cathode-side gap, and

said upstream portions of said cooling fluid channels are formed such that they include a region corresponding to a middle stream portion and subsequent portion of at least one of said fuel gas channel and said oxidant gas channel.

5. The fuel cell in accordance with claim 1,

wherein said anode-side gasket and said cathode-side gasket are continuous circular members,

in said anode-side separator and said cathode-side separator, a manifold aperture for supplying cooling fluid and a manifold aperture for exhausting cooling fluid connected by said cooling fluid channel are formed on the outside of said anode-side gasket and said cathode-side gasket, and

said anode-side gap and said cathode-side gap each have a first route and a second route longer than said first route.

6. The fuel cell in accordance with claim 1,

wherein said upstream portion of said cooling fluid channel of at least one of said anode-side separator and said cathode-side separator is formed in a region corresponding to said first route of said anode-side gap and said cathode-side gap.

7. The fuel cell in accordance with claim 1,

wherein said upstream portion of said cooling fluid channel of at least one of said anode-side separator and said cathode-side separator is formed in a region corresponding to said second route of said anode-side gap and said cathode-side gap.

8. The fuel cell in accordance with claim 1,

wherein said upstream portion of said cooling fluid channel of at least one of said anode-side separator and said cathode-side separator and a downstream portion of said gas channel are formed such that they correspond to each other.

9. The fuel cell in accordance with claim 1,

wherein, in at least one of said anode-side separator and said cathode-side separator, a flow direction of said cooling fluid that flows in an inside region of said cooling fluid channel from upstream to downstream and a flow direction of said reaction gas that flows in an inside region of said gas channel from upstream to downstream are substantially the same.

10. The fuel cell in accordance with claim 1,

wherein said cooling fluid channel, said fuel gas channel and said oxidant gas channel each have a serpentine structure.

11. A fuel cell stack comprising a plurality of fuel cells stacked,

wherein at least one fuel cell according to claim 1 is incorporated into said fuel cell stack as a fuel cell.